

Mercury Toxicity and Implications for Children's Health

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Division of Toxicology

Agency for Toxic Substances and

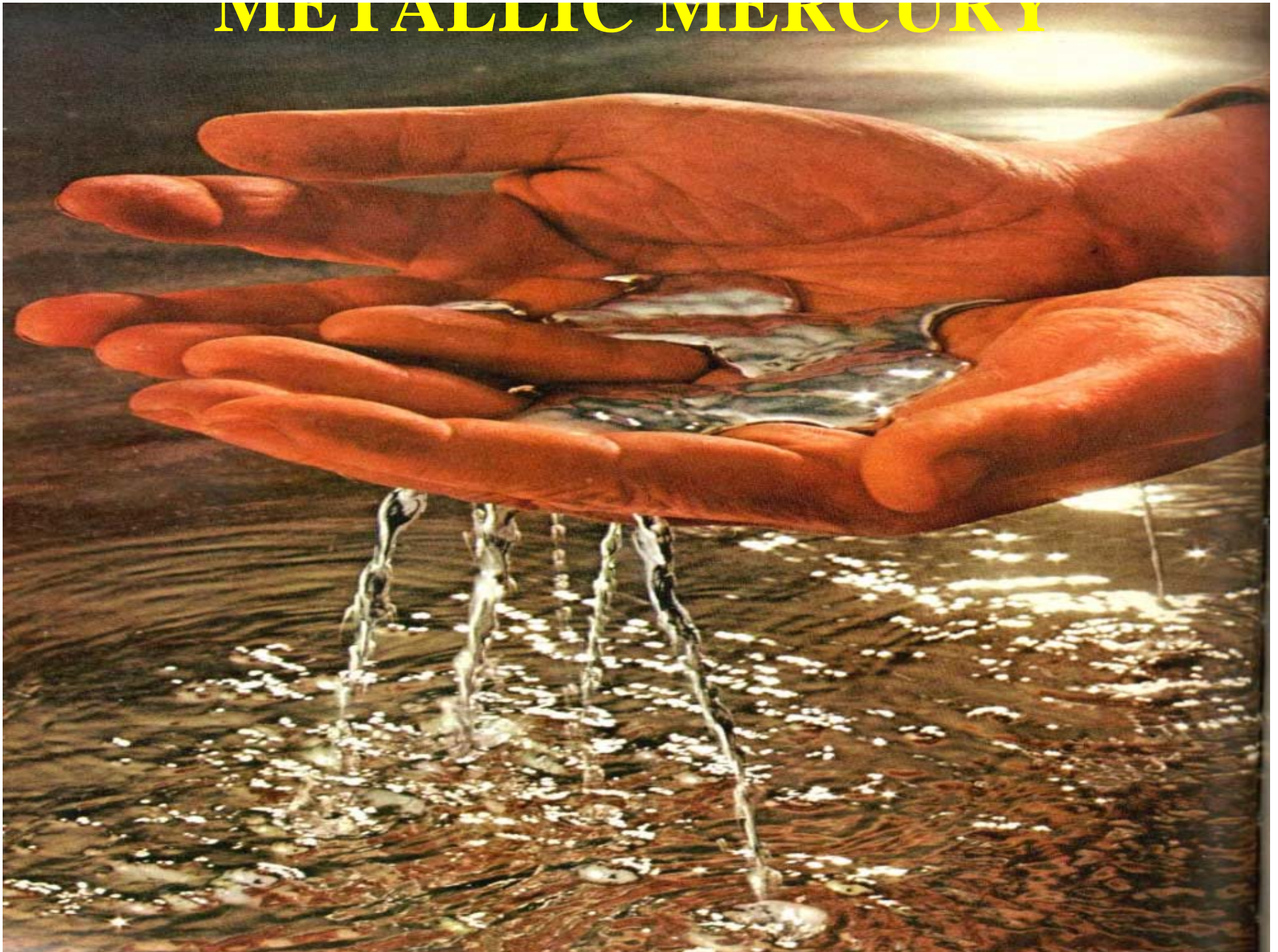
Disease Registry

Atlanta, Georgia

Forms of Mercury

- **Metallic (*a.k.a.* elemental, liquid)**
- **Inorganic compounds (*e.g.*, salts)**
- **Organic (*e.g.*, alkyl and dialkyl compounds)**

METALLIC MERCURY



Sources of Non-occupational Exposure to Metallic Mercury

- **Broken thermometers**
- **Barometers**
- **School science labs**
- **Leaking sphygmomanometers**
- **Abandoned industrial facilities**
- **Ethnic/folk**
- **Fluorescent light bulbs**
- **Other (suicide attempts; cigarettes, etc.)**

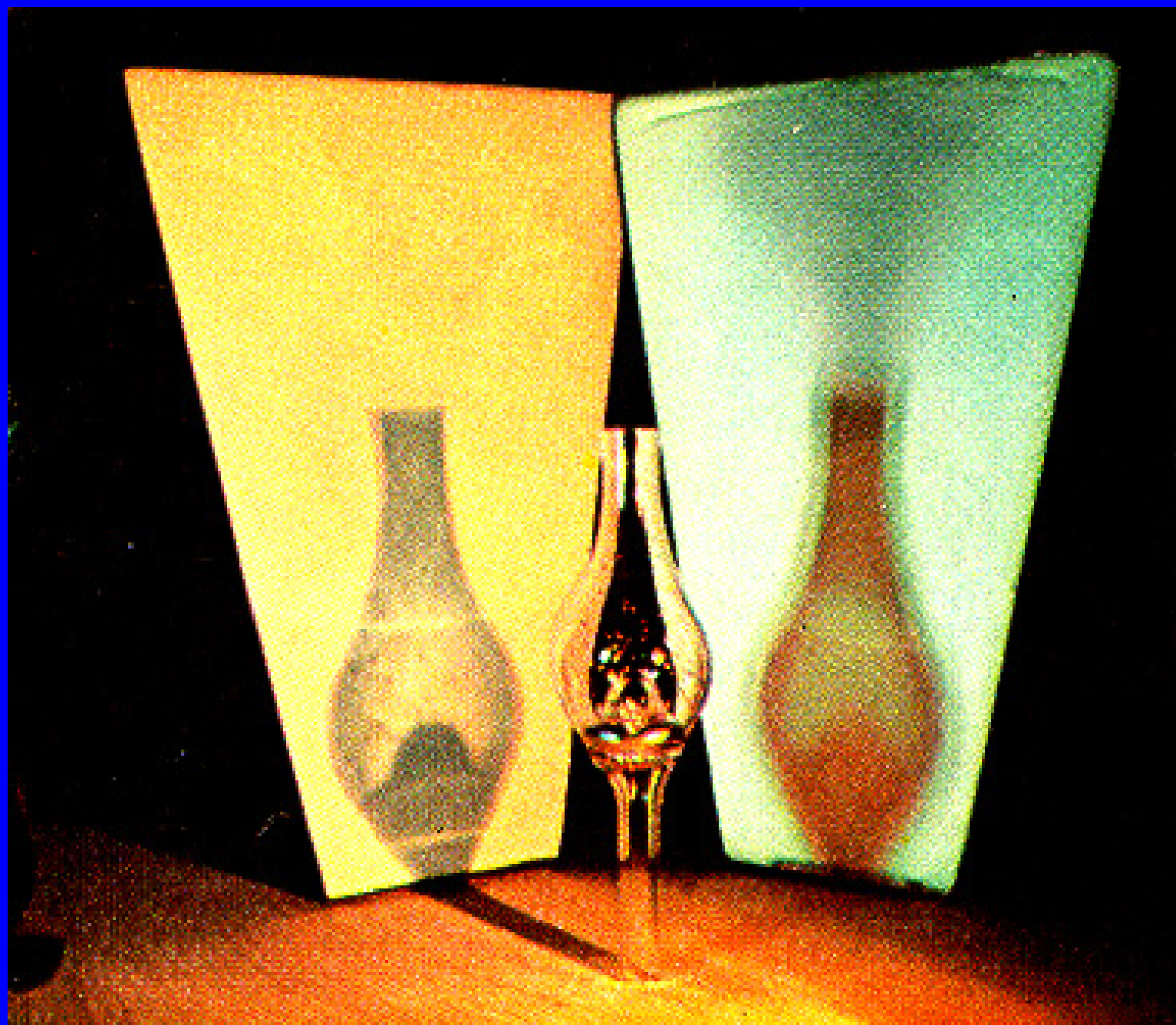
ROUTES OF EXPOSURE

(Metallic Mercury)

- **Oral**
 - **< 0.01% absorbed**
- **Dermal**
 - **virtually none absorbed**
- **Inhalation**
 - **approx. 80% absorbed**

Insufficient Knowledge of Metallic/Liquid Mercury

- **In recent incident involving the spill of metallic mercury in a school, a Poison Center physician was quoted as saying that “liquid mercury is not harmful unless it is heated up.”**
- **"It's completely harmless."**
- **“Mercury would not vaporize in the air unless it was heated.”**





Ethnic and Folk Uses of Hg

- Santeria
- Espiritismo
- Voodoo
- Palo Mayombe
- Chinese folk uses
- Mexican folk uses
- Other

Necklaces from Mexico



Medicinal Uses of Mercury

- Dental amalgam fillings
- Skin lightening creams (Hg^+)
- Ear drops
- Teething powders
- Diuretics
- Laxatives (calomel Hg_2Cl_2)
- Other cosmetics
- Thimerosal (~ 50% EtHg)
 - Merthiolate (brand of thimerosal)
- Mercurochrome (merbromin - mercuric)

Dental Amalgam

- **Approximately 50% metallic mercury**
- **Estimated daily intake of 1-5 ug/day in U.S. (DHHS); up to 19 ug/day worldwide (WHO)**
- **Exacerbated by bruxism or excessive chewing**
- **Primary source of exposure for those who do not work in an occupation using metallic mercury (or consume large amounts of ocean fish).**

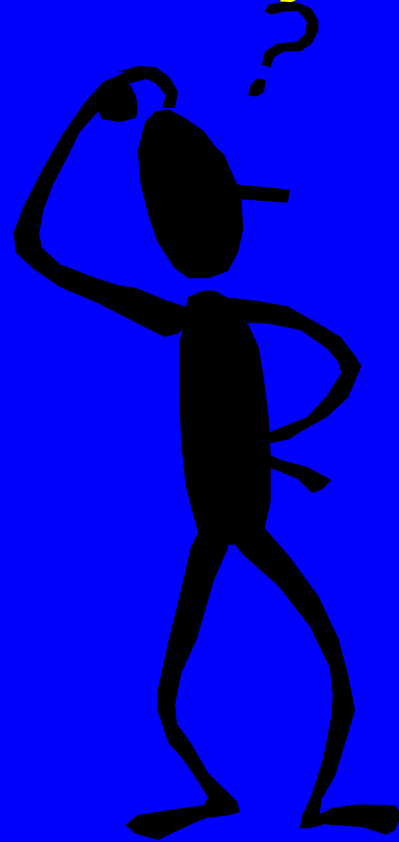
“Be careful about reading health books. You may die of a misprint.”

Mark Twain

EFFECTS OF MERCURY

- **Neurologic**
- **Cardiovascular**
- **Respiratory**
- **Renal**
- **Immune**
- **Dermatologic**
- **Reproductive/Developmental**

*How do I know whether I've
been significantly exposed???*



Biomarkers of Inorganic Hg Exposure

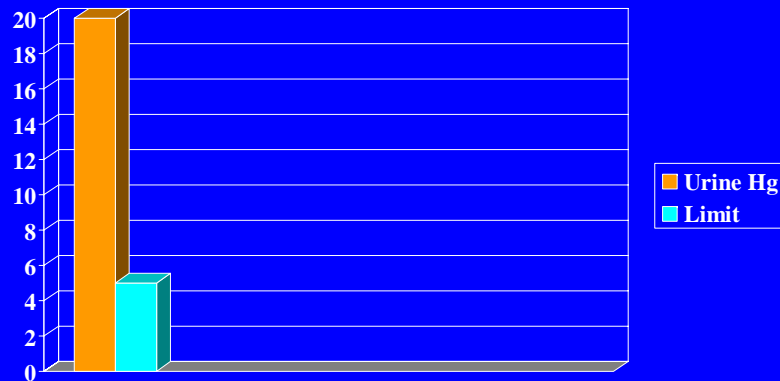
- **Urine**
 - Primary route of excretion
- **Blood**
 - Half life in blood only about 3 days
- **Hair**
 - Inorganic Hg not excreted in hair

Collection of Urine Samples for Inorganic Mercury Exposure

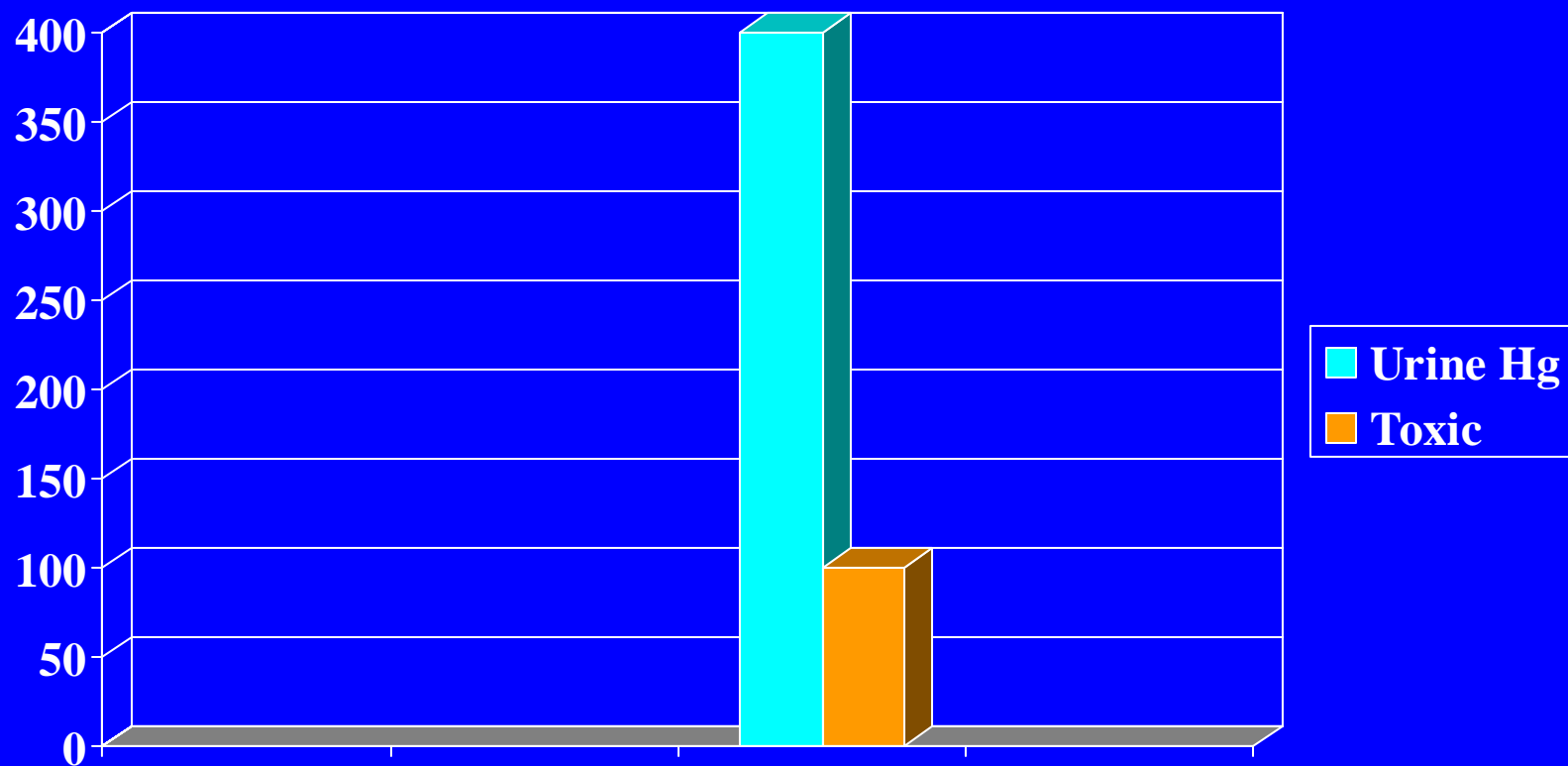
- **Urine Hg analysis will verify exposure**
- **Must be taken w/o chelating agent**
- **24-hour sample desirable**
- **Creatinine comparison adjusts for hydration**

Evaluating The Lab Report

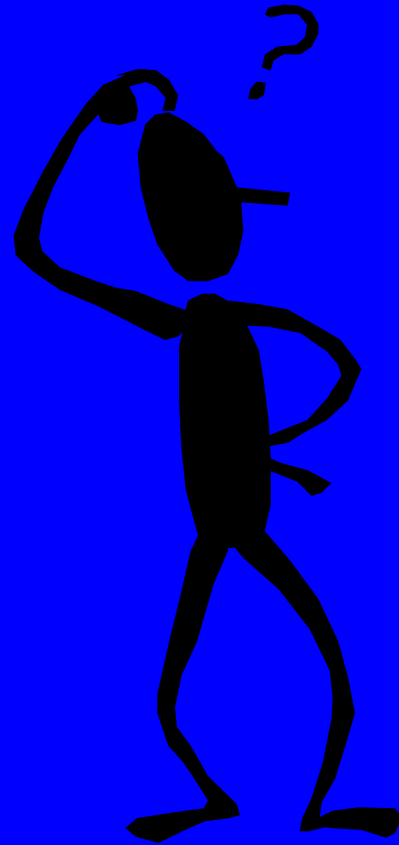
(in micrograms Hg per liter of urine)



Lab Says ‘400% of toxic level’



Am I going to die???



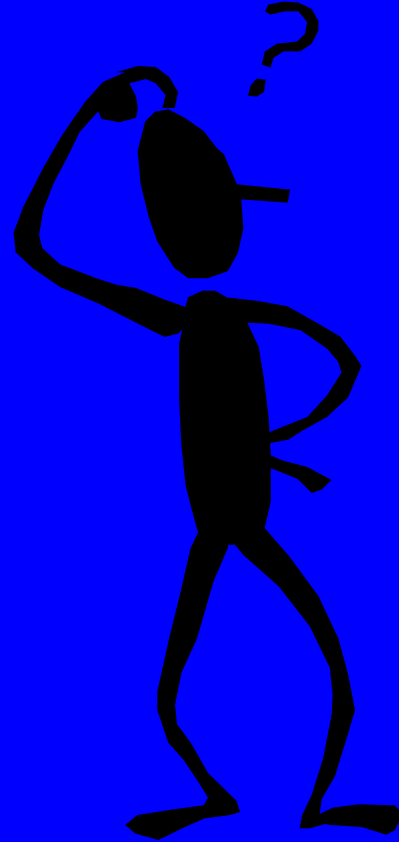
Interpretation of Results

- Range varies among labs
 - beyond upper end of range NOT necessarily bad
- Need to compare with background levels
- Need pre-chelation values

Comparison Values for Urine Hg

- 95th percentile values from NHANES (1999-2000)
- Taken from 1,748 women aged 16-49 years
- 5 ug Hg/L urine
- 3.27 ug Hg/ g creatinine
- 20 ug/L considered NOAEL (Goldwater, 1972)

***I Broke a Thermometer!!!
Now, what do I do???***



Cleaning-up a Metallic Mercury Spill – What Not to Do

- **Do not vacuum**
- **Do not sweep with a broom**
- **Do not track through spill**
- **Do not leave room unattended**
- **Do not try to mop up spill**
- **Do not try to blot with towels**
- **Do not panic!!!**

Metallic Mercury Spill - What You Should Do

- **Isolate spill; close off room**
- **Pick up any broken glass (using disposable gloves) and place it in a ziploc-type plastic bag; dispose of bag in outside trash**
- **Try to pick up remaining mercury with eyedropper**
- **Place eyedropper or paper in a ziploc-type plastic bag and dispose of outside the house**
- **To look for any remaining beads, darken room, separate fibers, and shine a flashlight onto area of carpet on which mercury spilled; remove beads with eyedropper; dispose of as above; wash hands**
- **Removal of carpet section or rug may be necessary**

Metallic Mercury Case Study # 1

- **Source:** middle school science lab
- **Quantity:** 4-6 fluid ounces (2 ½ lbs)
- **Used for “play activities” by 20 students**
- **Resultant contamination:**
 - School lab and hallways
 - Two residences
 - One family van

IN-HOME EXPOSURES

- **Bedroom:** 1,764 ug/m³
- **Bedroom hallway:** 106 ug/m³
- **Living room:** 53 ug/m³
- **Van: (floor)** 67 ug/m³
- **Van: (seat)** 287 ug/m³
- *RfC/MRL:* 0.3 ug/m³

Clinical Signs and Biomarkers

- 4 children underwent chelation for acrodynia and/or erethism
- Urine mercury values were 428, 350, 138, and 40 ug/L
 - only high concentration child was hospitalized
- 1 adult female had urine Hg of 134 ug/L
 - but was asymptomatic

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Organic Mercury Compounds

- Phenylmercury
- Methylmercury
- Ethylmercury
- Dimethylmercury
- Diethylmercury

Sources of Organomercurials

- **Phenylmercury**
 - **Paints prior to 1990**
 - **Pharmaceutical preservatives**
- **Methylmercury**
 - **Fish, waterfowl, aquatic mammals**
- **Ethylmercury**
 - **Pharmaceutical preservatives**
- **Dialkyl mercurials**
 - **Industrial processes**
 - **Calibration of certain laboratory instruments**

Biomarkers of MeHg Exposure

- **Urine**

- route of excretion only after demethylation

- **Blood**

- good indicator of exposure since MeHg tightly bound to RBCs

- **Hair**

- good for historical record of exposure due excretion

Comparison Values for Blood Hg

- 95th percentile value of 7.10 ug/L for 1,709 women aged 16-49 years
- 95th percentile value of 2.30 ug/L for 705 children 1-5 YOA
 - 2.10 ug/L for 387 males
 - 2.70 ug/L for 318 females

Comparison of Blood MeHg

- **ATSDR NOAEL:** 61 ug/L
- **EPA NOAEL:** 58 ug/L
- **53 YOA female:** 125 ug/L (symptomatic)
- **59 YOA female:** 24 ug/L (asymptom.)
- **71 YOA female:** 26 ug/L (symptomatic)

TREATMENT/INTERVENTION

- **Terminate exposure (~2 month half-life)**
- **Notify local health authorities**
- **Treat symptomatically/supportive measures**
- **Chelate only when necessary to stop significant effects (e.g., acrodynia) or prevent imminent adverse outcomes**

SUMMARY

- **Mercury is a naturally occurring element in the earth's crust.**
- **Man-made sources of mercury are often avoidable.**
- **Keep mercury-containing devices and products away from children.**
- **Use digital thermometers in homes and offices.**
- **When a spill occurs, minimize and mitigate exposures.**
- **Notify health authorities when public exposure suspected.**
- **Follow FDA/EPA/Local fish consumption advisories, particularly during pregnancy**
- **ATSDR toll-free toxicology information number: 1-888-422-8737.**